

Non-Intrusive, Distributed Gas Sensing Technology for Advanced Spacesuits, Phase II

Completed Technology Project (2015 - 2022)

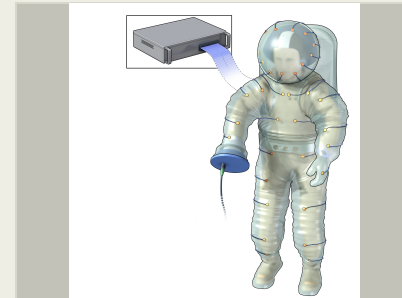


Project Introduction

Advances in spacesuits are required, to support the ISS and future human exploration. Spacesuit development and ground-based testing require sensing and analytical instrumentation for characterizing and validating prototypes. While miniature thermosensors measure reliably at low cost, and can be incorporated all around spacesuit prototypes, incorporating gas sensors at locations of interest inside a spacesuit has been a significant challenge – in particular for human subject tests – because of the size and cost of available instrumentation. The sensor probes and cables must not restrict the suit or human subjects' mobility, and must not disturb the gas flow. Intelligent Optical System is developing luminescence-based sensing patches for non-intrusive monitoring of critical life support gas constituents and potential trace contaminants in spacesuits. Flexible sensitive patches inside prototype spacesuits are interrogated via optical fibers, and do not disturb the gas flow or the human subject. This will give suit engineers great flexibility for choosing multiple sensing points, fitting the sensor elements into the spacesuit, and cost effectively relocating the sensor elements as desired. In Phase I, a first demonstrator was validated at Johnson Space Center by comparison with current instrumentation used in the Suited Manikin Test Apparatus. Phase II will produce an advanced system ready for integration into NASA programs, and for commercialization (TRL9).

Anticipated Benefits

The proposed technology will apply directly to accomplishing the objectives of the NASA Advanced Exploration Systems (AES) program, contributing to the rapid and effective development of novel EVA systems, and the demonstration of key capabilities for future human missions beyond Earth orbit. Exhaustive testing of prototype systems reduces risk and improves the affordability of exploration missions. The proposed technology will significantly enhance current capabilities for demonstrating, in ground-based testbeds and in flight experiments on the International Space Station (ISS), the prototype EVA systems developed in the AES program. In addition, sensor materials developed in this project will find direct application for life support system monitoring. Luminescence sensors for pO₂, pCO₂ and pH₂O have significant advantages over competing technology for the Portable Life Support system, including reduced size, low power and operation under wet conditions. Today IR technology remains the most accurate and stable CO₂ means of monitoring for the PLSS, but it is highly sensitive to free water that can condense or accumulate in the gas sampling area, particularly on optical windows. When NASA astronauts work hard in spacesuits, they sweat, creating moisture that has historically caused IR sensors to fail or give inaccurate readings. Luminescent sensors capable of operating while wet offer an alternative to overcome this limitation. The potential market for noninvasive sensor patches includes the industries that apply protective packaging to moisture- or oxygen-sensitive goods. Incorporating patches inside packages will enable the



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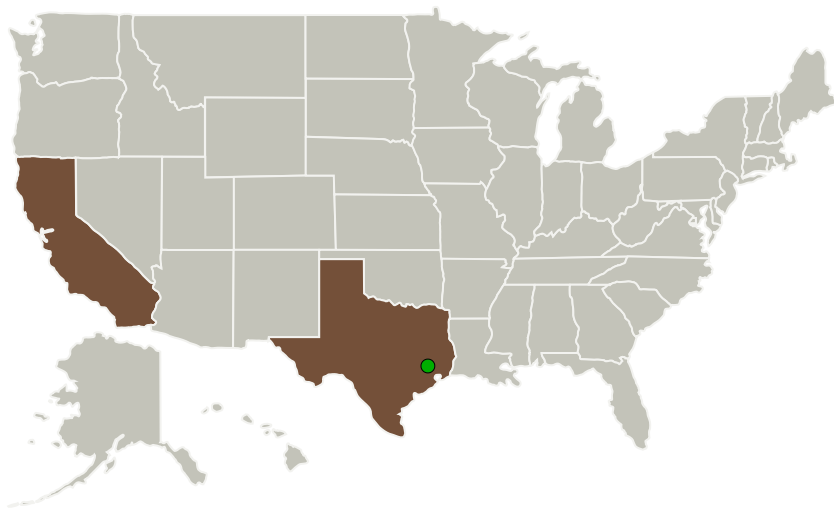
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users to check gas composition nondestructively throughout the life of the packaged product, assuring the integrity of the envelope. Packaging with gas barrier properties and/or modified atmospheres is used extensively for electronic components, hygroscopic chemicals, pharmaceuticals, food, animal feed, and surgical and dental instruments. Specifically adapting and calibrating the patch sensors will suit them for use in these industries.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Intelligent Optical Systems, Inc.	Lead Organization	Industry	Torrance, California
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations

California	Texas
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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Intelligent Optical Systems, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:

Kathryn B Packard
Cinda Chullen

Principal Investigator:

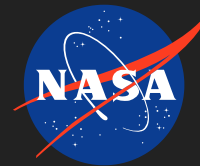
Kyle Brubaker

Co-Investigator:

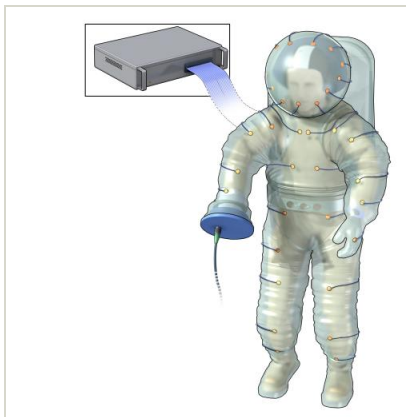
Jesus Delgado Alonso

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Images

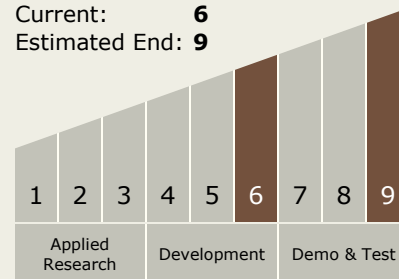


Briefing Chart Image

Non-Intrusive, Distributed Gas Sensing Technology for Advanced Spacesuits, Phase II
(<https://techport.nasa.gov/image/136877>)

Technology Maturity (TRL)

Start: 6
Current: 6
Estimated End: 9



Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System